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INDIAN SECTION.

No. 26.

BARLEY AND EUROPEAN BREWING
IN INDIA.

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PREFACE.

The Government of India have arranged to provide to the Imperial Institute for the illustration of the Economic Products of India—

- (A) a descriptive Catalogue or Dictionary;
- (B) an index collection of all products;
- (C) a commercial collection of special products;
- (D) a hand-book descriptive of C.

A.—The descriptive Catalogue has been completed, and is termed the "Dictionary of the Economic Products of India." The compilation has occupied eight years, and has been made under the Editorship of Dr. G. Watt, C.I.E., Reporter on Economic Products to the Government of India. It has been confined to the collation of facts and statistics available up to the date of the publication of the work.

To each product there is assigned in the Dictionary a separate number, which will be permanently maintained for purposes of reference.

B.—The index collection will, when completed, be comprised of small samples of every economic product of India, which will bear the same numbers as those assigned to the products in the Dictionary.

C.—The commercial collections are on a larger scale. The number of products of which a collection is provided each year will be limited to about twenty.

Each collection will comprise as complete a set of specimens of the product in its raw and manufactured state as is necessary for the fulfilment of the object with which the commercial collections and hand-books are provided.

D.—The hand-books will supply, in a separate pamphlet for each product, the information contained in the Dictionary, amplified by supplementary facts and statistics, and illustrated by maps, diagrams, photographs, etc.

The objects of the commercial collections and hand-books which accompany them are—

1. To secure, while each collection is being made for the Institute, a thorough and special investigation in India through which fresh information regarding the product concerned, not contained in the Dictionary, may be obtained.
2. To illustrate the Dictionary in a manner more complete than can be effected by the index collection.
3. In the case of products which are not generally known—
 - (a) to bring them to the notice of those interested;
 - (b) to indicate the extent to which, and conditions under which they are procurable;
 - (c) to ascertain their commercial value;
 - (d) to secure, through the Governing Body of the Institute and commercial experts whom they may consult, such special trial or analysis of them as can be more effectually made in England than in India.

E. C. BUCK,

*Secy. to the Govt. of India,
Dept. of Revenue and Agriculture.*

April 10th, 1893.

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[Barley is described in Dr. Watt's Dictionary of Economic Products, Vol. IV H. 382—407, and Brewing in Vol. V, M. 89—104.]

BARLEY.

In this hand-book the information contained in the articles by Dr. G. Watt and Dr. J. Murray in the Dictionary of Economic Products is reproduced with certain modifications and additions. Its special object is to draw attention to the extent of the cultivation of barley, and to the European breweries and methods of brewing in India.

Vern.—*Jav, jao, jawa, súj*, HIND.; *Ḥab, jau, jóo*, BENG.; *Jowa khar*, BEHARI; *Nas*, BHOT.; *Soah*, LASSA; *Tosa*, NEPAL; *Jau, indarjau, yurk*, N.-W. P.; *Thánzatt, náí, jawa, chak, jau* (cut as fodder, *kawíd, kasi, pathá, soá, jhotak, shiroka, tro, ne, chung, lúgar, búza, chang*), (spirits=*arrak*), (ashes=*jáwa khar*), PB.; *Jao-tursh, jao* (*H. hexastichum=jao-shirin*), AFG.; *Satú*, DEC.; *Sátu, jav*, BOMB.; *Java, sátu, jav*, MAR.; *Jau, jav, ymwah*, GUZ.; *Barlí-arisi, barlí-arishi*, TAM.; *Pachcha yava, yava, dhánya bhédam, yavaka, yavala, barlí-biyam*, TEL.; *Javegodhi*, KAN.; *Mu-yau*, BURM.; *Yava, yavaka, situshúka*, SANS.; *Shaaír*, ARAB.; *Ḥab, PERS.*; *Arpa*, TURKI.

HABITAT AND HISTORY.

An annual grass, producing many stems, from 2 to 3 feet long, from a single grain. The typical form has the spikelets arranged along the sides of a flattened rachis in groups of three; but in several of the varieties the lateral spikelets are more or less abortive. In the typical form they are developed, but are more or less irregularly arranged, while in the Indian cultivated barley they are grouped in six symmetrical rows. The only variety hitherto found wild, in any part of the globe, is *H. distichum*, Linn., which is probably indigenous to Western Temperate Asia. According to DeCandolle "it has been found wild in Western Asia, in Arabia Petrea, near Mount Sinai, in the ruins of Persepolis, near the Caspian Sea, between Leukoran and Bakú, in the desert of Chirvan and Awhasia, to the south of the Caucasus, and in Turcomania." Its modern

indigenous area is, therefore, from the Red Sea to the Caucasus and the Caspian Sea. As no other cereal can be cultivated under so great a variety of climate, its distribution as an agricultural plant is very extended. It occurs over all the temperate and extra-tropical regions of the world, growing at altitudes of 11,000 (and, according to Baden Powell, 15,000) feet on the Himálaya, and as far north as $68^{\circ}38'$ latitude in Lapland. Barley is amongst the most ancient of cultivated plants; but, as its forms resemble each other in their economic properties, and seem to have had, in all languages, a common name, it is very difficult to ascertain which variety is referred to by ancient writers. Proofs exist in abundance, however, that barley in one or more of its forms was cultivated in the remotest times. According to Bretschneider it is included in the list of five cereals sown by the Emperor Shen-nung of China, who reigned about 2700 B.C. Theophrastus was acquainted with several sorts of barley (*Κριθη*). It is frequently alluded to in the Bible, and must have been an important article of food in the time of Solomon (B.C. 1015). De Candolle, quoting Unger and Heer, tells us that the variety *hexastichum* which was known to Theophrastus, "has also been found in the earliest Egyptian monuments; in the remains of the lake dwellings of Switzerland (age of stone), of Italy and of Savoy (age of bronze)." A six-rowed barley is also represented on the medals of Metapontes, a town in the south of Italy, six centuries before Christ. There appears to be little doubt that the variety most cultivated in antiquity, as it is to this day in India, was *H. hexastichum*, Linn. *H. distichum*, Linn., was also grown and employed as a food-grain in pre-historic times, while the cultivation of *H. vulgare* proper seems to date from more modern times.

Since *H. distichum* is the only one of these which appears, at present, to exist in a wild condition, it would seem that the four and six-rowed barleys are either cultivated varieties of the two-rowed form, or that they owe their origin to a wild ancestor of their own type which has since become extinct.

The only variety cultivated to any extent in India is *H. hexastichum*. Little is known regarding its introduction or the origin of its cultivation in this country, but, from its having evidently been well known and valued by other Eastern peoples, it is probable that it was also grown at least in the north of India in very remote times. This supposition is confirmed by the intimate connection of the grain with several of the rites and beliefs of the Hindú religion. Thus the God Indra is called "He who ripens barley," and the grain is employed in the ceremonies attending the birth of a child, weddings, funerals, and in certain sacrificial rites. It is further supported by the antiquity of the Sanskrit name, *Yava*, which in the earliest times was probably applied as a general term to any grain or corn-yielding plant, and was only at a later date restricted to what, at that time, must have been probably the most important cereal.

In Gladwin's translation of the *Ain-i-Akbari* the crop is said to have been one of the most important in Afghanistan and Kashmir, and a large part of the revenue from these countries was obtained from barley, by exacting the usual two out of every ten *kherwars* produced.

CULTIVATION.

AREA.—It appears from the Agricultural Statistics of British India, that by far the largest quantity of this cereal is grown in the North-West Provinces and the Panjáb; Ajmere-Merwara, Bombay, the Central Provinces, and Madras following on the list very far behind the two first, but in the order given. For the sake of comparison the following statements of the acreage under cultivation in these Provinces, during the three years, 1885 to 1888, may be here given:—

		1885-86.	1886-87.	1887-88.
		Acres.	Acres.	Acres.
North-Western Provinces and Oudh.	Unmixed	1,349,000	1,716,400	1,670,800
	Wheat and Barley	1,145,300	1,233,100	1,210,800
	Barley and Gram	2,347,400	2,463,600	2,642,000
North-Western Provinces and Oudh		4,841,700	5,413,100	5,523,600
Panjáb		1,852,500	1,163,400	1,410,600
Ajmere and Merwara		63,300	50,610	36,200
Bombay		41,200	38,000	41,200
Central Provinces		8,600	Not given	Not given
Madras		3,900	...	3,700
TOTAL		6,811,200	6,665,100	7,015,300

Thus, excluding Bengal, and the Native States—tracts from which reliable statistics are not forthcoming—the total area averages about 7 million acres under barley, mixed or unmixed, of which more than three-fourths belong to the North-West Provinces. In these Provinces, Benares, Allahabad, Agra, and Rohilkhand are the most important barley-growing districts; in the last the grain is grown mixed with wheat; in Allahabad and Agra it is generally mixed with gram; while in the first it is most commonly grown alone. Barley, mixed and unmixed, occupies about 20 per cent. of the total calculated area in the thirty temporarily-settled districts of these Provinces, or 42 per cent. of the total area under spring crops.

The acreage under barley, unmixed with other crops, during the last four years has been returned as follows:—

PROVINCE.	1888-89.	1889-90.	1890-91.	1891-92.
N.-W. Provinces and Oudh	1,630,770	1,953,550	2,176,670	2,166,760
Panjáb	1,678,780	1,039,320	1,727,740	1,196,340
Ajmere-Merwara	37,240	35,600	37,600	37,000
Bombay Presidency	67,080	63,050	55,040	55,810
Central Provinces . . . . .	...	...	15,520	12,500
Madras	3,900	3,550	3,530	3,530
Bengal		Not available.		

METHODS.—*North-West Provinces.*—The method of cultivation in this, the most important barley-growing region, may be taken as typical, and will accordingly be fully described. Barley is a *rabi* or spring crop, being sown in October and reaped in March or April. As already mentioned, it is not only grown alone, but also mixed with wheat, when the crop is called *gojai*, or with gram, peas, or lentils, when it is known as *bijra*, or (in the tracts below the hills) *gochin*. Messrs. Duthie and Fuller state that the areas under barley alone, barley-gram, and barley-wheat stand in the relative proportions of 11, 22, and 10. One of these crops is usually the *rabi* accompaniment of indigo or rice, since it is considered much better adapted than wheat alone, for growth on a soil which has not been allowed to recuperate itself by even six months' fallow. Rape (*Brassica campestris*), Indian mustard (*Brassica juncea*), and *duán* or *tara* (*Eruca sativa*) are also commonly sown in barley fields either as a border, or in rows some 15 feet apart; linseed is also occasionally grown as a border. The soil (which is generally light and sandy, and but sparsely manured, except when the wheat-barley mixed crop is to be grown) is prepared in *Assauj* (September-October) by ploughing and cleaning, and, when practicable, the fields are irrigated by turning a stream into them from some neighbouring river. The amount of ploughing necessary seems to vary much in different districts; thus in Rohilkhand the operation is frequently performed as often as twelve times, while in Bundelkhand two or three are considered sufficient. Probably four ploughings is the average throughout the Provinces. Sowing in the irrigated fields takes place in October-November, and in the uplands in November-December, a little later than the sowing time of gram, and earlier than that of wheat. The seeds are sown in plough furrows either by hand direct, or down a hollow bamboo fastened to the plough stilt, to the average amount of about 100 lb an acre. After the sowing is completed, the seeds are covered in by the plough, the coarse clods of earth are broken by the *dalaya* (mallet) and again smoothed by a heavy flat wooden log, drawn by oxen, and kept steady by a man standing on it. Irrigation may or may not be employed, according to the amount of winter rainfall, and in districts which enjoy a tolerable certainty of these rains, it is but rarely carried out. A comparison of the total irrigated and unirrigated crops of the several divisions of the Province shows that irrigation is carried on to the greatest extent in Agra and Benares, to the smallest in Meerut and Rohilkhand, while the total irrigated crop is less than two-fifths of the whole.

Barley requires very little weeding, or at least receives little, so with the exception of possible irrigation, the crop is left very much to itself till the season of ripening in March-April, when it is reaped like wheat, by being cut in the middle of the stalk with a sickle, tied in sheaves, and stacked near the homestead to dry. When quite dry, these sheaves are unbound and threshed out by a flat board with a short handle, termed a *mungra*, or in some of the north-eastern parts of Kumáon by a primitive form of flail, consisting of a long pliant stick. The grain thus separated is said to be mixed with the ashes of cowdung before being stored, to prevent the attacks of insects. In the case of mixed crops the barley and gram, or barley and wheat, are reaped, stored, and eaten as one.

COST AND AVERAGE OUTTURN.—Messrs. Duthie and Fuller give the following estimate of the total cost of growing an acre of barley:—

	R	a.	p.
Ploughing (four times)	3	0	0
Clod-crushing (four times)	0	8	0
Seed (120lb)	2	8	0
Sowing	0	14	0
Reaping	1	8	0
Threshing	3	0	0
Cleaning	0	6	0
TOTAL	11	12	0

Irrigation (twice)—	R	a.	p.
Canal dues	1	8	0
Labour	2	8	0
Rent	5	0	0
GRAND TOTAL	20	12	0

The outturn of barley is, under similar conditions, from one-fourth to half again as much as that of wheat. When irrigated, the average may be taken as 16 maunds to the acre of unmixed barley, 15 of wheat-barley, and 14 of barley-gram, while on unirrigated soil the average is from 8 to 11 maunds for unmixed barley, from 7 to 10 for barley-wheat, and from 6 to 9 for barley-gram, the amount varying with the winter rainfall of the district. The average outturn of straw is about one and a half times that of the grain. In mixed crops about three-fifths of the total produce is barley. (*Duthie and Fuller, Field and Garden Crops.*)

Experiments were conducted in the Government Experimental Farm of the North-Western Provinces and Oudh at Allahabad in 1872 for the purpose of introducing the English two-rowed barley into that province. In the report on these experiments it is stated that the country barley, *H. hexastichum*, gave a yield of nearly double the English grain. These results discouraged further attempts, but they appear strangely at variance with the outcome of later experiment carried out in the Nilgiris, and described below in treating of Madras.

The average price realised for Barley during the past twenty years in this province has been 1 rupee for from 27 to 28 seers.

Panjáb.—The largest areas are in the districts of Peshawar, Sirsa, Ferozepore, Hissar, and Gurgaon. The system of cultivation is very similar to that already described as pursued in the North-West Provinces; but the practice of topping an over-leafy crop, which is never followed in the latter region, is said to be common, and the crop is generally grown unmixed, *gojai* and *bijra* being almost unknown. As in the North-Western Provinces, the crop in this province receives very little special attention. Thus in the *Karnal Gazetteer* the system is described as follows: “Men may be seen sowing barley at the very end of the season on the edges of a swamp, still too wet to plough, with the intention of ploughing it as the soil dries. The limit to sowing is expressed by the proverb ‘*boya Po, diya kho,*’ ‘Sow in Po, and you lose your seed.’ The field is ploughed two to four times, the *sohagga* is passed over it, and the seed sown broadcast. Manure is given if there

is any to spare, which there seldom is, and water is given if the needs of the other crops allow of it. It is seldom weeded unless the weeds are very bad."

In 1876 an important and interesting official correspondence was carried on regarding the quality of Panjáb barley, which arose from complaints made regarding it by the Veterinary Department. From this correspondence it appears that the quality of the grain, at least at that time, suffered severely from its being cut before it was quite ripe, and from its being carelessly stored while damp, or in a damp place. One firm of brewers who were applied to for an opinion reported that, by buying the barley immediately after it was reaped and threshed, and storing it themselves, they obtained a most excellent grain; while two other firms who apparently bought the barley when required for use in October, had great difficulty in obtaining even fairly good barley, a large percentage being dead, mouldy, or weevil-eaten. These facts point to careless and ignorant methods of storing as the principal cause of the frequently inferior quality of the grain, and to this being the point requiring attention in endeavouring to improve it.

The outturn per acre varies greatly in different districts, but the average agrees with that in the North-West Provinces. The average price of the grain during the past twenty years has been between 31 and 33 seers per rupee.

Central India and Rájputana.—Barley is largely cultivated both in Ajmere-Merwara and in Rájputana proper, especially in its more northerly portion. The system of cultivation is, on the whole, similar to that previously detailed, but the crop appears to be generally ploughed about six times, manured, weeded at least once, and irrigated; in fact, to receive altogether more attention than in many other parts. The cost of production is about R28, the value of the crop about R34, and the consequent profit about R6 per acre.

Bombay.—It is principally grown in Gujarát. In an interesting report on the subject the Acting Director of Land Records and Agriculture writes: "In 1887-88 Gujarat alone had more than three-fourths of the total area of barley-cultivation in Bombay. It is less important in the Deccan. In Gujarat it is generally an after-crop in garden rice lands, or in soils too sandy and open for wheat. It is irrigated and manured. The garden rice land is, previous to cultivation, manured to the extent of 12 cart-loads, watered on the stubble in December, then ploughed twice and levelled. The seed to the extent of 80 to 100lb is immediately thrown by hand into the furrows, the sower following the plough. It is then rolled and watered six or eight times, and harvested in April. The estimated acre yield is from 1,020 to 2,270lb. According to experiments conducted on this crop, the cost per acre comes to about R20, and the value of produce to about R21. The fact that it is not subject to the wheat blight renders it a favourite rain crop in the light lands of Ahmadnagar and Kaira. In the Deccan it is grown as a garden crop, and rarely as an after-crop in rice fields."

Central Provinces.—The crop of barley in these provinces is very insignificant, the area under it during the year 1891-92 being only 12,500 acres.

Madras.—As might be expected from the climate of this province, barley is a very unimportant crop, only from 3,000 to 4,000 acres being cultivated on the spurs and slopes of the Nílghiris and Palnis. Endeavours were, however, made by the Agricultural Department in 1885-86, to improve the quality of Nílghiri barley, and to increase the extent of its cultivation, by introducing good seed both from the Panjáb and England, and distributing it to the rayats. To ensure success and to help the people with advice and instruction, these experimental trials of foreign seed, though conducted by the rayats (farmers) themselves, were placed under the supervision of an agricultural inspector. In the report of the Department for 1886-87 it is stated that the results with English barley (*H. distichum*) were very satisfactory, a good crop having been obtained, which was purchased by the Nílghiri Brewery Company. Panjáb barley, on the other hand, was found to be inferior to that already grown in the district, and accordingly attempts to introduce the latter have been stopped. English barley is further favourably commented on in the report for 1887-88, in which it is mentioned that during 1887 nearly 5,000 bushels of seed were sold at an average price of ₹1.12 per bushel. Every endeavour is being made to increase the cultivation of this important malting grain, for which there is great demand, and, as a consequence, a considerable augmentation of the area under cultivation and yearly outturn in the Presidency may be expected.

During 1890-91 prizes were offered for samples of barley grown on the Nílghiris. To secure proper competition, samples were only allowed to be entered when produced in plots of half an acre or more, and the samples for exhibition were obtained direct from the threshing-floors. Though the season was unfavourable, the samples were superior for malting purposes to those of the previous year. All the samples were raised from seed of English origin.

Bengal.—No returns are available of the area under cultivation, and the crop as a whole is unimportant. The Director of Land Records and Agriculture mentions that it is cultivated in the Bhagalpur Division, and to a limited extent in Chutia Nagpur. As in other districts, it is a *rabi* crop, being sown in October-November and reaped in March-April. The ground is prepared by three or four ploughings, at intervals of four or five days. The seed is then sown and the soil harrowed, and ploughing and harrowing are repeated after three days. No mention is made of any further attention, in the form of irrigation or weeding, being paid to the crop.

Burma.—The Government of Burma reports: "In Mandalay it is the margin paddy of the district. It is sown in the month of January, and reaped in the month of May, averaging 120 days; the cost of cultivation being about ₹12 per acre, and the proceeds about ₹25. It is an inferior kind of grain, and only eaten by the poorer classes. In the Thongwa District it is grown in a very small area, there being not even 50 acres in all. It is cultivated indiscriminately, and at little cost. In the Yamethin and Meiktila Districts margin paddy is grown extensively. No returns are available regarding the total area under cultivation."

In 1889-90 barley seed supplied by Government, which was issued in Shwebo, yielded only a poor light crop. Other seed, however, gave

better results, the barley being said to have been particularly heavy and fine. Barley was also grown at Nyaungbintha post on dry black cotton soil unirrigated in any way. It gave good results as to grain, but the straw was light. In the Report of the Department of Agriculture, 1888-89, it is stated that "much barley is already grown in the north of the Sagaing District in the dry black cotton soil around Taungnyo and Kekka, and there is a considerable quantity of similar land uncultivated in the southern portion of this district, where it could be grown. There is much good land for barley elsewhere in the southern subdivision." In 1889-90 barley sown in the Upper Chindwin District yielded twice the weight of the seed sown. In 1890-91 barley was distributed to Thayetmyo, Ye-u, and Minbu, but failed in all cases, the failure in Ye-u being that the seeds were weevilled; in the other two cases the season was unfavourable.

TOTAL PRODUCTION AND CONSUMPTION.

By far the greater proportion of barley grown in the country is consumed locally, a very small quantity being exported. An attempt has been made by the calculations shown in the adjoining table to arrive at a fairly accurate estimate of the actual total outturn of the grain in India during the year 1887-88, excluding Bengal, Native States, and tracts from which no reports are available. The result is necessarily (from the number of averages which had to be employed in compiling it) only at best an approximation, but it errs, if to any noteworthy extent, on the side of under-estimation, and may be interesting for purposes of comparison with the trade statistics.

Such a comparison shows that of the total production of 46,604,007 cwt., 42,179,869 cwt. were consumed in the country during the year under consideration.

Table showing calculation of total production of Barley in India, excluding Bengal, Native States, and Tracts from which Statistics are not forthcoming in 1887-88. (Maund=82lb.)

CROP.	APPROXIMATE ACREAGE. (Returns of areas outside the North- West Prov- inces taken as Unmixed Barley.)	APPROXIMATE YIELD PER ACRE.	TOTAL YIELD OF CROP.	TOTAL YIELD OF BARLEY. (In mixed crops barley = $\frac{2}{3}$ of the whole.)	
				Maunds.	Cwt.
<i>Unmixed—</i>		Maunds.	Maunds.	Maunds.	Cwt.
Irrigated .	1,581,250	16	2,53,00,000	2,53,00,000	18,523,214
Unirrigated .	1,581,250	9 $\frac{1}{4}$	1,46,26,562	1,46,26,562	10,708,732
<i>Barley-wheat—</i>					
Irrigated .	484,320	15	72,64,800	43,58,880	3,191,322
Unirrigated .	726,480	8 $\frac{1}{4}$	59,93,460	35,96,076	2,632,841
<i>Barley-gram—</i>					
Irrigated .	1,056,800	14	1,47,95,200	88,77,120	6,499,320
Unirrigated .	1,585,200	7 $\frac{1}{4}$	1,14,92,700	68,95,620	5,048,578
TOTAL .	7,015,300		7,94,72,722	6,36,54,258	46,604,007

Taking into account the increase in the area under barley that has taken place in the North-West Provinces since 1887-88, and making allowance for the decrease in Panjáb, the total production of the grain in the year 1891-92 may be roughly estimated at 50 millions cwts.

TRADE.

IMPORTS.—Separate returns of the imports of this cereal are not made either by sea or trans-frontier; it is therefore to be presumed that the quantity is so small as to be unworthy of special notice.

EXPORTS are also very small in comparison with the approximate annual production. The exports to different countries during the five years, 1887 to 1892, are shown by the following table:—

Country.	1887-88.		1888-89.		1889-90.		1890-91.		1891-92.	
	Cwt.	R	Cwt.	R	Cwt.	R	Cwt.	R	Cwt.	R
United Kingdom .	1,487	3,803	710	2,398	18,986	54,857	522	1,957	4,790	19,304
Zanzibar .	391	1,261	1,119	3,691	368	1,308	1,536	5,101	1,663	6,159
Aden .	1,814	4,644	3,984	11,529	1,559	4,480	1,341	3,604	761	2,080
Arabia .	7,675	21,024	2,026	7,514	2,659	8,365	658	1,880	...	...
Ceylon .	7,539	29,800	9,626	26,363	5,301	18,511	1,536	6,224	148	560
Persia .	10,358	28,437	...	...	...	...	...	...	...	...
Belgium .	...	...	4,000	13,000	...	...	...	...	...	...
Mauritius .	...	...	2,962	8,715	2,845	9,345	1,935	5,550	29	111
Straits Settlements	...	...	343	1,011	622	1,845	191	500	364	930
Abyssinia .	...	...	...	...	...	...	75	200	19	65
Mekran and Son- miáni.	...	...	...	...	...	...	146	500	...	...
Hong-Kong .	...	...	...	...	...	...	83	265	104	358
Other countries .	311	807	283	728	126	358	...	...	...	...
TOTAL .	29,575	89,776	25,053	74,949	32,466	99,069	8,023	25,781	7,878	29,567

The share taken by Bengal, Bombay, and Sind (Kurrachee) in the export of the above was as follows:—

Year.	Bengal.		Bombay.		Sind.	
	Cwt.	R	Cwt.	R	Cwt.	R
1887-88 . .	6,873	20,556	18,688	58,632	4,014	10,588
1888-89 . .	7,796	19,961	15,131	48,877	2,126	6,111
1889-90 . .	935	2,720	10,452	35,466	21,079	60,883
1890-91 . .	274	765	3,977	14,602	3,772	10,414
1891-92 . .	468	1,288	1,859	6,895	5,551	21,384

The export of barley to foreign countries is so insignificant that, prior to 1887-88, the grain was not separately mentioned in the Annual Reports of Trade and Navigation, but was classed under the heading of "Other sorts of grain." The following statement shows the exports during the years 1890-91 and 1891-92:—

COUNTRIES TO WHICH EXPORTED.	1890-91.		1891-92.	
	Quantity.	Value.	Quantity.	Value.
	Cwts.	R	Cwts.	R
United Kingdom . . .	522	1,957	4,790	19,304
Abyssinia	75	200	19	65
East Africa—Zanzibar . .	1,536	5,101	1,663	6,159
Mauritius	1,935	5,550	29	111
Aden	1,341	3,604	761	2,080
Arabia	658	1,880	...	...
Ceylon	1,536	6,224	148	560
China—Hong-Kong . . .	83	265	104	358
Mekran and Sonmiāni . .	146	500	...	...
Straits Settlements . . .	191	500	364	930
TOTAL	8,023	25,781	7,878	29,567

The provinces from which the barley was exported were as follows:—1890-91: Bengal 274 cwts., value R765, Bombay 3,977 cwts., value R14,602, Sindh 3,772 cwts., value R10,414; 1891-92: Bengal 486 cwts., value R1,288, Bombay 1,859 cwts., value R6,895, Sindh 5,551 cwts., value R21,384.

CHEMISTRY.

"The grain of *H. hexastichum* is frequently used in this country instead of that of the officinal plant, and is exactly similar in medicinal properties. Chemically the grains contain (along with the food-forming constituents, which will be discussed hereafter) from 13 to 15 per

cent. of water, and after drying they yield about 3 per cent. of fat oil, with insignificant proportions of tannin and bitter principles, residing chiefly in the husks, and 2·4 of mineral ash. The oil, according to Hanamann, is a compound of glycerin with palmitic and lauric acids, or less probably with a peculiar fatty acid. The ash was found by Lerner to contain 29 per cent. of silicic acid, 32·6 of phosphoric acid, 22·7 of potash, and 3·7 of lime. Besides these constituents Linter in 1868 demonstrated the presence of a little cholesterin in the grain, and still later Kühnemann extracted from it a crystallized dextrogyrate sugar, and an amorphous lævogyrate mucilaginous substance, sinistrin, and demonstrated the absence of dextrin." (*Flückiger and Hanbury.*)

MEDICINE.

The husked seed of *H. distichum* occupies a place in the Pharmacopœias of England, the United States, and India, under the name of HORDEUM DECORTICATUM or Pearl Barley. The grains of this variety of prepared barley are sub-spherical or ovoid, about two lines in diameter, of a white farinaceous appearance, and have the peculiar taste and odour common to most of the cereal grains. An account of the preparation of "pearl barley" will be found under the heading Food.

Barley is demulcent, and easy of digestion, and is for these reasons much used in the dietary of the sick. In India *saktu*, or powder of the parched grains, is much employed in the form of a gruel in cases of painful and atonic dyspepsia. In European practice Barley water, a decoction of the grain, is principally prescribed, and is valuable in cases requiring demulcent treatment. Dr. Irvine states that in Patna the ashes of the leaf are employed in the formation of cooling sherbets; and Stewart writes that the ashes of the stalks are prescribed for indigestion in the plains of the Panjáb. Preparations of malt have acquired some reputation of late years in Europe and America, since they are more demulcent and nutritious than those of the unmalted barley. Malt extract may be prepared by boiling two to four ounces of the germinated and dried grain in a quart of water and straining. When hops are added, the decoction becomes wort, and acquires tonic properties, which have been found especially valuable in cases of debility following on long-continued chronic suppuration.

FOOD.

The food-forming constituents of average husked Indian barley are, starch 63 per cent., cellulose 7 per cent., albuminoids 11·5 per cent., with small quantities of oil, ash, fibre, and 12·5 per cent. of water. The nutrient-ratio is given by Church as 1 : 6·3 and the nutrient value as 84·5. On comparison of the above with the results of analyses of English barley, it will be found that the latter show a smaller percentage of albuminoids. The process of cleaning barley for food purposes is, in this country, carried out, as a rule, by pounding in wooden mortars and

winnowing, or, in the North-West Provinces, as already described, by beating with a flat board. It is then ground into coarse meal, from which either alone, or mixed with the meal of wheat or gram, *chapattis* or unleavened cakes are made and baked; or a thick gruel or pasty mass is made, to which a little salt is added, and the preparation is eaten with garlic, onions, or chillies. In either of these forms it is a staple article of food of the poorer classes in many parts of the country, especially in the North-West Provinces, the Panjáb, and Oudh.

The grain thus roughly cleaned and ground is much more rich in albuminoids than the more carefully-prepared culinary barley of Europe, partly owing to the higher percentage of nitrogen naturally existing in the former, partly to the amount of the richly albuminoid husk left by the imperfect methods of cleaning it. Though this fact renders Indian barley meal of higher nutritive value than English, it at the same time makes it more difficult of digestion, and hence partly unsuits it for the dietary of dyspeptics and invalids generally.

The grain in England undergoes an elaborate process of cleaning, by which several different sorts of barley are produced, to which various names are given in commerce. This process consists essentially in passing the hard dried barley between horizontal millstones, placed so far apart as to rub off its integuments without crushing it. The millstones may be a little approximated, and by this means results are obtained varying in cleanness. Church, in describing the process, writes: "100lb of barley yield $12\frac{1}{2}$ lb of coarse dust, and become "Blocked Barley." By closer and longer grinding Blocked Barley yields $14\frac{3}{4}$ lb of fine dust, and becomes "Pot" or "Scotch Barley," which again, on being further ground, yields $25\frac{1}{4}$ lb of "Pearl dust" and becomes "Pearl Barley." Thus from 100lb only $37\frac{5}{8}$ lb of pearl barley is obtained, 10 per cent. of actual loss unaccounted for occurs, and the remainder consists of the "dusts" above mentioned. These dusts, though generally considered waste products, are of considerable nutritive value, and might be utilised, as the following figures given by Church will show:—

	Coarse Dust.	Fine Dust.	Pearl Dust.
Water	14'2	13'1	13'3
Albuminoids	7'0	17'6	12'1
Oil	1'7	6'	3'4
Starch	46'9	50'5	67'2
Fibre	24'5	8'5	1'8
Ash	5'7	4'3	2'2

Church, however, takes care to mention that, in point of fact, the figures representing percentage of albuminoids are in all these cases too high, because the nitrogen from which they are calculated does not exist altogether in the albuminoidal constituents, and suggests the deduction of $\frac{1}{3}$ from the totals given as probably likely to yield a more accurate result.

Barley in one or other of these forms is much employed in European cookery as a bland demulcent grain in the preparation of soups, etc. It is also employed by the poorer classes in certain localities to make bread.

FODDER.

Barley has of late years attracted considerable attention owing to its cheapness and value as a fodder. It has long been employed in the Panjáb for this purpose, the crop being cut two or even three times when quite young without marked injury to the final yield of grain. (*Stewart.*)

In the report on the Experimental Farm of Hyderabad in Sind for 1886-87, it is recorded that experiments were tried, during the previous year, to determine the pecuniary benefit of growing it purely as a fodder, with the result that the balance was very much in favour of this method even in a year when fodder was very cheap. The exact outcome of this interesting trial may be shortly given in tabular form:—

No.	Area.	Description.	YIELD PER ACRE.	
			Grain.	Straw.
	Gunthás.		lb	lb
1	8	Cut before ripening	...	21,740
2	8	Cut in grain, green	...	14,925
1, 2	(Same plots)	Second cutting	{ 56	280
			{ 62	310
3	8	} Cut ripe	{ 2,145	4,270
4	8		{ 2,931	4,428

The total value of the yield of plots 1 and 2 was ₹94-5-2, of 3 and 4 ₹77-0-8, or a balance in favour of the fodder crop of ₹17-4-6.

The straw of even ripe barley is a fairly good fodder when cut up as "*bhúsa*," but is inferior to that of wheat. The grain is a good feed for both horses and cattle, either given alone, or mixed with gram, when it is known as "*adaur*."

DOMESTIC, INDUSTRIAL, AND SACRED USES.

The grain is much employed in parts of India in the preparation of a kind of beer, or spirituous liquor, and its value for this purpose has been long known. The Sanskrit *Yavasura* is an intoxicating drink prepared from barley. Stewart writes regarding the employment of barley for this purpose in the Panjáb: "In Lahoul and on the Sutlej a kind of beer is made from its grain, the ferment in the former case being brought from Tibet as little farinaceous-looking cakes, the size of a fig, called *pab* or *phap*. In Ladák also a similar beverage is made by the aid of the same substance, which is said to be made in Drás, to the West, from barley flower mixed with cloves, cardamoms, ginger, and an herb which is

probably an Umbellifer, (and then fermented?). On the Sutlej, Moorcroft states that, in the preparation of the beer, rice is mixed with it, and the root of a bitter aromatic obtained from higher altitudes is added to prevent indigestion. In Lahoul, Aitchison mentions that spirits made from barley are used by some of the richer inhabitants, and spirits are also made from it in Ladák."

The straw is used in many parts of the Panjáb hills in the manufacture of sandals.

Barley is required for many of the ceremonials of the Hindu religion. It is considered a symbol of wealth and abundance, is claimed by astrologers as a "notable plant of Saturn," and is in India particularly associated with the god Indra. It is specially introduced in the ceremonials attending the birth of an infant, weddings, funerals, and at certain sacrifices. On the fourth day of the light half of the month "Vaisákha" a sort of game is played in which people throw barley-meal over each other, known in the Sanskrit as *Yava-chaturthí*.

HISTORY OF EUROPEAN BREWING IN INDIA.

The history of the manufacture of malt liquors in India, is, to some extent, the history of a series of unsuccessful efforts at establishing an exotic industry, in a country then unfavourably placed for its prosperity as a remunerative enterprise. It is only within recent years, as a consequence of the growth of large European communities and the existence of army contracts, given out by Government to the Indian brewers, that the industry has at last been able to firmly establish itself in this country.

"The pioneer brewer in India appears," says Mr. Whymper, "to have been a Mr. Henry Bohle, who commenced business at Meerut and Mussoorie in 1825. His attempts were, however, very disappointing, and in 1852 his business passed into the hands of his partner, Mr. John Mackinnon, the founder of the firm of that name now in Mussoorie. It was not, however, till about the year 1870 that success dawned upon the enterprise. In the meantime, between the years 1850 and 1860, several small breweries were opened in hill stations, most of which operated but for a short time, and then failed. In fact, it may be said that one only of the early breweries of Northern India has survived. It was started at Kasauli by Captain Bevan, who, in 1854, finding it a fruitless enterprise, disposed of his interest to Mr. Dyer. The concern thereafter passed into the hands of a Company, and subsequently was bought by Mr. Meakin, who still retains an interest in it and has made it a success."

In 1860, a brewery on a more pretentious scale was started by Messrs. Conill and Hay in Simla. The lines on which it proposed to work may be said to have foreshadowed its failure. Even the bricks, which were employed in the construction of the buildings, were imported from England at an enormous cost. Expenditure on other branches of the concern was equally reckless, and the business closed and finally passed into the hands of Mr. Meakin. Balfour (*Cyclopædia of India*) says that in Southern India Captain Ouchterlony initiated the industry about 1850. He failed, and was followed by Mr. Honeywell, who may be said to have carried on the business ever since. A curious

experiment, Mr. Whymper tells us, was made at Bangalore not long after, *viz.*, to manufacture beer from imported concentrated wort, but it is probably needless to add that this venture also proved a failure. It would be beside the purpose of the present article to refer to the establishment of each and every brewery in India. Suffice it to say that there are now 25 breweries at work, of which 20 have been established since 1870, and of these 12 have sprung into existence within the past ten years (1879—89). This progress may be still further exemplified by the figures of outturn. In 1881 some 21 breweries were working, and these produced 2,448,711 gallons, of which the Commissariat Departments purchased 1,764,927 gallons. During the succeeding eight years (1882—89) the production and Government purchases rose steadily until, in 1889, the figures stood at 5,165,138 made in India, and 3,778,295 gallons purchased by Government. In the previous year the Government purchases of Indian beer amounted to 4,628,175 gallons:

Of the 25 breweries at work during 1889 the following were the more important :—

The Murree Brewery Co., Limited, at Murree (1,148,949 gallons), at Ráwalpindi, (205,632 gallons), at Ootacamund (336,558 gallons), at Bangalore (267,408 gallons), with smaller concerns at Quetta and Ceylon; Meakin & Co. at Poona (501,816 gallons), at Kasauli (450,000 gallons); with smaller breweries at Chakrata, Darjiling, Dalhousie, and Ranikhet; Dyer & Co. at Lucknow (340,038 gallons), at Mandalay (232,804 gallons), at Solon (133,272 gallons); Mackinnon & Co. at Mussoorie (183,591 gallons); also the Crown Brewery Co. carrying on business at Mussoorie (411,183 gallons); and the Naini Tal Brewery Co., at Naini Tal. The total outturn for the year was returned at 5,165,138 gallons.

Mr. Whymper, in concluding his historic sketch of Indian breweries, remarks:

“There are few Indian or Native breweries in the Mysore State. They are of slight consequence. About 1875 a brewery was started at Bandora near Bombay. The peculiar feature of this establishment was that tidal water was used in brewing. This water was frequently quite salt, and the beer was very nauseous; it however kept sound in a most remarkable manner. The beer was sold for some time in Bombay.

“The brewery which works most satisfactorily under the most trying conditions to be met with in India, is said to be that at Dapooree, near Bombay. This belongs to Messrs. Meakin & Co. The writer visited this brewery on the 22nd April 1886. The temperature of a well-shaded verandah at 8 that morning was 93°; at noon it was 106°; the brewery office at the same time was 100°. By using a five-ton ice machine as much as possible, the average pitch heats had been about 75° in that month. Nothing had been pitched under 72°. One gyle had to be pitched at 88°, it rose to 101°, at which the attemperators were able to hold it. Beers, brewed under nearly the same unfavourable conditions three months before, were examined, and were perfectly sound to the palate. The writer is fully aware this will not receive ready credence in England. The owner, Mr. H. G. Meakin, is an elder brother of the Burton maltsters, and possesses an unusually venturesome spirit, which has so far carried with it well-merited success.

“It must not be supposed that all brewers have anything like such unfavourable conditions to contend with as Mr. Meakin has had. The majority of Indian breweries are situated in the mountains of Northern India, or of the Madras Presidency. There is one brewery at Lucknow which has only a very short winter, but still it does have some cold weather, whereas the Dapooree one has none. The breweries in the Northern Hills (as the mountains are always called) have cold winters; some have as much as six months’ good brewing weather, and Messrs. Mackinnon are so well situated that they can brew sound beers all the year round. The breweries in the Nilgiri Hills in Madras, and the brewery in the Ceylon Mountains, both being at an elevation of over 6,000 feet, can also brew every day in the year for export trade. The trade of the latter is principally with Lower Burma. Sir Samuel Baker was the pioneer brewer in Ceylon, but it is doubtful if he ever foresaw that Ceylon would eventually have an export beer business. The Murree Brewery Co. purchased the present brewery site from a German firm, which did not succeed in brewing to meet the public taste.

“The brewery at Quetta has, perhaps, the most extraordinary climate of all Indian positions, the sun being so intensely hot, even in the winter months, that a brewer has to wear a sun helmet, whilst at the same time he has to clothe himself in a fur-lined coat to protect himself from the biting cold which there is in the shade. Whilst prospecting for a brewery site, the servants of the Company suffered from both sun and from frost-bites. The cold which is occasionally experienced is too great to make it safe to employ much steam power, and although the Company, in the first instance, erected a steam plant, it had to be replaced by the open boiling system; pipes, pumps, and injectors, steam pressure gauges, and blow-off cocks were all frozen up, and burst in the most impartial manner.”

MATERIALS AND METHODS OF BREWING.

I.—THE GRAIN.

Barley is, of course, the grain employed in India. The following account of it is taken from Mr. Whymper’s paper:—“The barleys used by the Indian brewer are entirely grown on the Peninsula. The breweries in the South imported Persian grain and English malt until very recently, but now Northern barleys are carried down and malted at the breweries. The range of Indian barleys is considerable, and the quality varies to a great extent. Grain weighing nearly fifty-two pounds to the bushel is grown as far south as 24° north latitude. The best grain, however, is found about 28° north latitude, in the North-West Provinces, and extreme South Panjáb, where fifty-six pounds weight to the bushel is procurable. In Northern India a curious custom prevails of cutting the whole crop down to the ground, when about to throw into ear. Cattle are fed on the green stuff so cut, and the barley is allowed to grow again, and, strange to say, it does not seem very much worse for this treatment. In the hills in Madras two crops a year are grown, but

the grain is hardly ever allowed to ripen properly, and, consequently, occasions malting difficulties. Barley has been grown in Ceylon and used in brewing, but it is not likely to be permanently grown there, not being a sufficiently valuable crop. All Indian barleys require more warmth and moisture in malting, especially if grown on irrigated soil, than European barleys. Maltsters in England have complained of Indian barleys not germinating freely. It is open to question whether they have sufficiently allowed for the fact that they are dealing with grain grown under totally different conditions to that which they have been usually accustomed to malt. It should be remembered that Indian barley which would find its way to Europe is seed from an almost semi-tropical plant, and naturally requires much more warmth and coddling than English barley. It should be kept up to 60° in the cistern, and kept thick on floors. It will not be injured by warmth when growing. The great drawback to its use is the large quantity of weevil found in some samples. The Indian crop is cut at varying dates, according to latitude, from March to May. The hot weather then sets in, and the grain undergoes a hot summer season and several months of monsoon weather before it is malted. The contrary holds good in England, where barley, after harvesting, is stored in cold weather until required for malting. The spread of weevil in Indian samples is thus very understandable. Natives believe that weevil will never be found in old buildings to the same extent as if stored in new granaries, and they attribute this entirely to the dampness of all new buildings. The writer believes there is something in this view, from facts which have fallen under his notice. There can be no doubt that the quantity of weevil can be minimised by shipments being made to England in June and July, and by great care being exercised in storing the grain in very dry places. Sun kills weevil."

Mr. Whympers has obligingly furnished for this work the following additional facts which in some respects supplement the passage quoted:—"Indian barley, from growing in a warmer and drier climate than in England, requires more warmth in the malting process and less water than in England. Generally speaking, Indian barleys germinate more freely than English, French, or Belgian. I do not know of any other difference. There is no doubt Indian grain would be improved, if zemindars could be induced not to cut the crop down for green fodder.

"Chevalier barley seed was given away freely by the Murree Brewery Company in the Hazára District about 1870, and in the Nilgiris in 1887-88; but with poor results. The following localities produce very good malting barleys:—Hazára, Ludhiána, Delhi, Rewari, Fazilka in the Panjáb; Allahabad, Mirzapur in the North-West Provinces; but ordinarily good barley can be procured almost anywhere in the Panjáb and North-West Provinces, and in parts of Rájputána. Bombay and Madras Presidency Breweries are supplied from the north. Indian Barley varies in weight from 46 to 56lb per bushel."

The barleys of the Panjáb and North-West Provinces are fairly well adapted for brewing purposes, but it is generally found that the percentage of "Extract," as compared with English grain, is below the mark. This has been traced to many causes:—poor seed, unfavourable soil,

the objectionable practice of preserving the grain in cow-dung, cutting down the crop for green fodder, and causing it to spring again and yield its grain, exposure of the grain to severe atmospheric changes, careless handling in packing and transit ; these and many other defects tend to lower the value of Indian barley for the maltster. But perhaps the most pernicious practice of all is traceable to the middleman, *viz.*, the adulteration of new grain with old, the mixture being sold as fresh stock. When this done, the brewer has no end of trouble, and often heavy pecuniary loss owing to irregularity in germination.

In concluding these remarks regarding barley suitable for brewing, the following useful passage from Spon's *Encyclopædia* may be quoted as giving the English experience :—"The selection of the barley used by the brewer calls for the exercise of much skill and judgment ; unless the quality be of the very best, it is impossible to obtain good malt, and without good malt, it is useless to attempt to make good beer. A practised brewer can judge of the quality of his barley by its appearance. The heaviest, if in good condition, is always the best ; the grains should be plump, and of a pale-yellow colour ; they should have a thin skin and a free, chalky fracture. That which has been grown in a light soil and harvested early, is also preferable. It is of much importance to the maltster that barley be lodged in the stack for a few weeks before being thrashed, in order to allow the moisture from the soil to dry off before it comes into his hands. If this is done, the operation of drying in the kiln is avoided. In moist districts, however, where the grain never gets thoroughly dried, this process must invariably be had recourse to ; the temperature of the kilns must never be allowed to arise above 50° (120°.) Care must be taken to avoid breaking or crushing the grains of malting barley, so as to minimise the chances of its becoming mouldy in the subsequent processes of malting—a contingency which should be avoided in every possible way. It should also be screened before steeping, in order that the grains may all be of equal size on the spiring floor. These remarks, of course, apply only to the brewer, who is, as he ought always to be, his own maltster."

II.—HOPS.

The following are the principal kinds of hops known to Indian trade :—

Austrian.—Bohemia is the principal hop-cultivating province of the Austrian Crown lands. The hops of the district of Saaz, which are of the red variety, are universally preferred.

German.—Bavaria is the principal hop-cultivating country of the German Empire. The hops from Spalt (city and country) are most prized.

English.—The hops of Kent, Sussex, Hereford, Hants, Worcester, and Surrey, are not an especially fine but very productive article.

American.—The centre of the hop-cultivating district is Utica, in the State of New York. Both varieties are grown and are rising in favour.

Hops are very liable to deterioration in the variable temperature of India. On this account special precautions have to be observed in

packing and storing them. The influences which exert an injurious effect upon the quality of hops are moisture and atmospheric air. Several methods have been recommended to protect hops from these evils. Smoking with sulphur was once much in vogue, and still is to some extent ; but it is considered by experts to be of doubtful advantage by itself. Combined with pressure of the hops within an air-tight receptacle, it has been found to answer admirably. A double packing cloth is used, and in addition the bales are covered with varnished paper, or enclosed in well-soldered tin or pitched wooden boxes.

Speaking of hops Mr. Whymper (in the paper already alluded to) says :—“ The hops used in India are nearly all imported, for, although there are hops growing in Kashmír and in Kúlu, the quantity as yet offered has been small. Some very fair quality hops have been grown by a Major R. Rennick in the Kúlu valley, and he is persevering with the growth. Australian hops are very serviceable, as they are picked about April and can be used in India early in June, thus supplying a new hop when most wanted.” In reply to an enquiry as to the hops most generally used in India Mr. Whymper writes :—“ I am not aware that any Indian brewers have a particular preference with regard to hops. All use various kinds or, in other words, ‘ blend ’ various kinds in order to get regularity of flavour as is customary in England. The dry climate of India naturally tells against hops stored in this country, and the Indian brewers cannot thus safely hold very large stocks.”

The following statement shows the quantity and value of the hops imported into India during the five years 1887-92 :—

Year.	Cwt.	R
1887-88	5,838	4,74,345
1888-89	5,434	5,94,734
1889-90	4,672	3,69,775
1890-91	3,920	7,69,274
1891-92	4,064	3,86,813

III.—YEAST AND FERMENTATION.

The choice of yeast and its treatment for future use are of great importance. If the brewer desires a favourable course of fermentation, he must first of all set the wort with good yeast. It may, indeed, be said that, out of a hundred cases of defective fermentation, ninety-nine can be traced to the bad quality of the yeast. Good brewing yeast is that which thrives best at a low temperature. The deterioration of yeast in this country is due to the high temperature at which fermentation has to be carried on, especially in the plains. A free use of ice would mitigate the evil ; but at the same time it would seriously increase the selling price of the beer.

The Indian brewer has often on this account to propagate his exotic yeast in the cool climate of the hills, and send to the plains supplies as required at the breweries. The result of this treatment is that the plant is in a constant state of deterioration, and a continuous fresh supply from Europe becomes necessary.

Mr. Whymper has kindly furnished the author with the following instructive reply to the enquiry regarding yeast :—" Indian brewers now very generally preserve yeast by drying it with charcoal powder. It only requires to be mixed with the charcoal, and dried at a moderate heat. In this condition it will remain active for many months. This system has not been many years in use. Prior to my knowing of it, I used, whenever possible, yeast preserved in plasters of sorts. Mr. Percy Adams, of Halstead, Essex, preserves good yeast made up in small marbles. Formerly I used dessicated yeast made up with powdered plaster-of-paris. This never gave such good results as the solid balls. But these methods of preservation are not absolutely necessary, as yeast can be produced in India. I can now undertake to start a true alcoholic fermentation in malt wort by the mere addition of the dust from the skin of barley. It may be said that it is now accepted that the dust or bloom of barley contains germs of several ferments."

IV.—WATER.

Mr. Whymper has obligingly furnished the writer with the analyses of some of the principal waters used by Indian breweries. These have been made by Government analysts, and can therefore be depended upon as accurate. Space cannot, however, be afforded for the publication of these in this work, but in purity from organic and other injurious materials they are second to none, while they possess the necessary amount of salts to render them good brewing waters. Thus the water used by the Crown Brewery Company contains 46·62 grains of inorganic salts to the gallon. The proportion of these salts varies slightly ; in one of the returns they amounted to only 41·8640 grains per gallon, the sulphate of magnesia being 14·06, carbonate of magnesia 7·57, sulphate of lime 8·78, and carbonate of lime 6·46.

Most of the Indian breweries use spring water filtered and boiled before being used.

V.—BREWING.

The following information furnished by Mr. H. Whymper will be read with special interest as giving facts of an Indian nature :—" The brewing season for nearly all Indian breweries is restricted by the short winter. In Oocatamund the temperature allows brewing to be carried on all the year round, but elsewhere the season is from October to March. The worts are cooled in the ordinary manner, first by exposure on shallow vessels termed coolers, and thereafter by flowing over ordinary refrigerators through which cold water flows. Cellars are cooled by being left open in the coldest weather. No artificial means of cooling has yet been adopted, but the largest brewery (that recently erected at Rawalpindi) is now constructing powerful ice machinery for cellar cooling.

" The class of beers, etc., made in India is practically the same as in England ; more light gravity beer is consumed, however, than in England. Wood is almost invariably employed as fuel, except for drying malt on kilns, when charcoal is used.

" Labour is much more expensive than in England (*a*) from the large number of men required to do the simplest job, (*b*) from the careless and

indifferent manner in which work is done, and in which machinery is treated."

VI.—BARRELS, VATS, BOTTLES, CORKS, ETC.

Before proceeding to discuss the trade in Beers and Ales, it is necessary to say something about the construction of beer-barrels, etc. The barrels or casks used in the breweries of this country are almost without exception constructed of oak, and are either made up in India from rough staves imported from the Baltic, or imported in shook, *i.e.*, bundles from London and remade in this country. Several attempts have been made to utilise the indigenous timbers of this country for barrel-making, but the extensive and various forests of India have failed up to the present moment in producing a wood good enough to replace the English or European oak. *Sál* (*Shorea robusta*) has been tried with some success in the construction of vats. White Cedar from the Malabar Coast makes a good-looking vat, but its use is somewhat dangerous in consequence of the absorbent nature of the wood rendering it very liable to crust. The English oak would find a strong competition in the Indian Ash and Teak, if the former could be got in larger quantity and the latter at cheaper rates. Deodar, and the wood of Pines generally, impart their resinous properties to the beer. The brewers of India are very anxious to find a wood which would successfully compete with the expensive and indispensable English oak, but hitherto the efforts to find such a timber have been unsuccessful. The valuable characteristics of oak are its freedom from knots, its density, durability, and lightness. It is also non-absorbent, and thus not liable to impart its resin to the beer.

In some experiments tried with the wood of various oaks, as materials for beer-barrels, Messrs. E. Dyer and Company, of the Burma Brewery, found casks made from two varieties (*Quercus glauca* and *Quercus serrata*) useless, as the wood was too porous and the beer oozed. A third species (*Quercus semiserrata*) is reported to have good, straight-grained wood, free of knots, very nearly resembling imported oak, and the casks made out of it retained the beer well. Unfortunately the difficulties in the way of transport render its price prohibitive. But, if the economic value of the tree comes to be known, and its cultivation on a wide scale is undertaken in suitable localities, the gradual extension and improvement of internal communications may in time bring this wood into the market.

Quercus semiserrata (*thitkya*, Burm.) is an evergreen tree, found on the plains of Assam and Kachar and on the Garo and Khasua hills, up to an elevation of 3,000 feet. It occurs also in Burma from Pegu to Tenasserim.

Bottles are purchased in the country. Mr. H. Whympers experimentally manufactured bottles at Jhelum from local materials for some time, but was unsuccessful, and accordingly abandoned the enterprise. Corks are all procured from England. Brewer's grains, that is, refuse malt, is usually sold by contract to zemindars or cattle owners, and in most cases is easily disposed of, but the price obtained fluctuates with the value of the fodder crop.

TRADE IN BEER AND OTHER MALT LIQUORS.

Mr. H. Whymper in his article on *Brewing in India* gives the following historic sketch of the trade in imported beer in this country :—

“What was termed country-brewed beer was very generally made in India at the close of the last century, and early in this. This is said to have consisted of about one-fifth of a bottle of porter (English), a wine-glassful of toddy or palm juice, some ginger and brown sugar, a squeeze of lime completing the ingredients. The toddy itself supplied the fermenting power, and, when this mixture had slightly fermented, it was considered fit for use. This drink was in vogue when a London brewer, Hodgson by name, about the year 1816, began to ship a well-hopped and rather heavy beer to India. It quickly became known as India pale ale, and Hodgson speedily acquired a complete monopoly of the Indian trade. Until 1825 or 1826 he held the Indian market at his mercy, and his mercies were cruel. He kept out rivals at times by lowering his rates below cost price, and, having stopped other brewers' shipments, up his prices went. It is reported that on more than one occasion he suddenly raised his price to £20 per hogshead. In 1824 he advanced to £24 per hogshead, and refused all credit. The result was what he might have foreseen; a revolt of all interested in the beer trade taking place. This was about 1825. Very shortly after this we find the beers of Bass, Allsopp, and ‘Ind and Smith,’ in the market against Hodgson, and by 1840 his beers were only a memory.

“There is no doubt in the writer's mind that, had the early shippers only kept up the quality of their beers, the whole of the Indian trade might have been in their hands at this moment. Although plenty of good beer went out, the general quality almost invariably fell off, or failed to meet the public taste after a few shipments. Occasionally such bad beers were in the market that it was inevitable people should say: ‘Well, if we can't get better beer than that, we might as well brew our own, as we couldn't possibly brew worse:’ this certainly occasioned at least one essay in the early days of Indian brewing. The shipments of beer for the use of the army were not a very great, if any, exception to this rule. Plenty of good beer went out, but, every now and then, the Government was startled by thousands of hogsheads of beer proving so bad that they had to be run into the nearest sea or river. It was thus no peculiarly favourable local circumstances which caused the rise of the brewing industry in India. There are no such circumstances, there are difficulties which every English brewer who goes to India looks upon at first as insuperable; but beers which did not meet the public taste and were inferior and bad, coupled with high prices, gave the Indian brewer his chance. All that the Indian brewer has in his favour is being nearer to the markets he sells in. Against this he has endless difficulties; he has to import and order, and often pay for ahead, his hops, casks, and machinery; he has to keep in reserve duplicates of everything likely to break down. He has to import all his supervising staff of servants; if he gets an unsuitable man he has to put up with him. His most serious difficulty is that, owing to the above circumstances and from

having to do all his own malting, he has to employ three times the capital he would have to do in England for a similar trade to his own."

"The writer's experience," continues Mr. Whympier, "does not go back beyond 1866. In that year, and for several years after, the declared quantity was about 200,000 barrels; it is now about 60,000 barrels. The value was then about £600,000, and it now averages about £200,000. The quantity of beer brewed in India in 1866 was probably not more than 2,500 barrels, certainly not more than 3,000, whilst in the present year it will possibly reach to 170,000 barrels, and will certainly be over 150,000 barrels. The limit of the whole trade to be done with the European population of India is probably 250,000 barrels."

"The trade will not likely expand beyond this until the Government relaxes certain rules, which, whilst they restrict the sale of beer in some districts, unquestionably foster the consumption of spirits. In Southern India, for instance, the brewer is not allowed to brew beer for native consumption above a certain alcoholic strength, and this strength is not sufficient for the native palate."

Turning to the official records of the Beer Trade, the following table may be given of the foreign beers bought into India. It will be observed that the imports fell off steadily from 1866 to 1878-79, but that from the latter date they have since steadily increased, until, at the present time, they are nearly as large as they were prior to the existence of Indian breweries:—

Import of Malt Liquors from Foreign Countries.

Years.										Gallons.	R
1866-67	.	.	.	.	.	.	.	.	.	Not given.	55,20,245
1867-68	.	.	.	.	.	.	.	.	.	2,268,298	43,57,701
1868-69	.	.	.	.	.	.	.	.	.	1,816,106	38,17,734
1869-70	.	.	.	.	.	.	.	.	.	1,898,762	41,35,199
1870-71	.	.	.	.	.	.	.	.	.	1,642,131	31,16,860
1871-72	.	.	.	.	.	.	.	.	.	1,499,877	30,53,186
1872-73	.	.	.	.	.	.	.	.	.	1,536,496	36,34,956
1873-74	.	.	.	.	.	.	.	.	.	1,435,345	33,77,155
1874-75	.	.	.	.	.	.	.	.	.	1,481,698	34,98,438
1875-76	.	.	.	.	.	.	.	.	.	1,143,157	26,81,065
1876-77	.	.	.	.	.	.	.	.	.	1,176,922	27,06,644
1877-78	.	.	.	.	.	.	.	.	.	1,328,077	31,30,700
1878-79	.	.	.	.	.	.	.	.	.	1,089,211	24,45,685
1879-80	.	.	.	.	.	.	.	.	.	1,065,347	25,42,620
1880-81	.	.	.	.	.	.	.	.	.	1,152,678	28,49,349
1881-82	.	.	.	.	.	.	.	.	.	1,199,395	28,46,121
1882-83	.	.	.	.	.	.	.	.	.	1,170,554	27,23,226
1883-84	.	.	.	.	.	.	.	.	.	1,261,444	30,32,236
1884-85	.	.	.	.	.	.	.	.	.	1,066,913	24,99,272
1885-86	.	.	.	.	.	.	.	.	.	1,299,408	30,06,098
1886-87	.	.	.	.	.	.	.	.	.	1,715,638	35,40,257
1887-88	.	.	.	.	.	.	.	.	.	2,138,518	39,71,534
1888-89	.	.	.	.	.	.	.	.	.	2,398,580	41,28,517
1889-90	.	.	.	.	.	.	.	.	.	2,797,965	46,21,100
1890-91	.	.	.	.	.	.	.	.	.	2,785,574	41,97,714
1891-92	.	.	.	.	.	.	.	.	.	2,973,943	44,51,424

The countries whence the malt liquors were imported (subject to duty at the rate of 1 anna per imperial gallon, or six quart bottles) in 1891-92 were as follows :—

Country.	Gallons.	R
United Kingdom	2,844,574	41,31,486
Austria	3,699	8,367
Belgium	3,842	9,916
France	129	222
Germany	117,437	293,192
Holland	704	1,746
Italy	3	10
Egypt	6	20
United States	20	49
Ceylon	2,283	2,244
China—Hong-Kong	2	3
Persia	2	2
Russia in Asia	8	16
Straits Settlements	1,229	4,145
Australia	5	6
TOTAL	2,973,943	44,51,424

The following interesting information relating to the trade in malt liquors has been derived from Mr. J. E. O'Connor's annual Reviews of the Trade of India, 1889—92 :—

1889-90.

“Fifteen years ago (in 1875) the imports of malt liquor suddenly fell from an average of about $1\frac{1}{2}$ million gallons to an average of a little more than one million, remaining at this point for ten years, when they began to increase. The trade since 1884-85 has been steadily augmenting year after year, and its dimensions are now nearly three times as great as they were six years ago (see table above).

“Various causes may be assigned for this remarkable augmentation of trade. The character of the beer has changed, and many are able to drink the lighter qualities now imported who were unable to drink the heavier beers that were formerly imported. There has been a great increase in the classes of the European population accustomed to drink beer habitually—artisans, workers in mills and factories, men employed on railways and inland and coasting steamers, and so forth. There has also without doubt been created a taste for beer among the Madras coolies who work for high wages in Burma, and return annually to Madras with their earnings (the imports into Madras and Burma have increased much more largely than in other provinces). The strength of the British army has been largely augmented, and the prices of beer have materially fallen. But it is hardly likely that these causes alone can have brought about such a sudden development in consumption, and the most effective cause must be sought in competition. The English brewers keenly felt the competition of the German and

Austrian brewers, and actively sought to retain a market which seemed to be undermined from without by continental beer, and from within by Indian beer. At the same time the practice recently adopted by the large English brewers of 'tieing' public houses restricted the clientèle of the smaller brewers, and forced them to seek openings in the foreign markets for a production which was in excess of home requirements, and the conversion of private breweries into limited companies has been followed by the necessity of showing increased sales. Hence the pushing of beer in the Indian and other external markets."

1890-91.

"The Government has terminated, since the end of 1890, its contracts with the Indian brewers for the supply of the troops in the Madras and Bombay Presidencies, and as the importers of European beer are actively competing for the custom of the British soldier, it is probable that the imports of beer will not recede from the high level they have reached in the last three years. What effect the new arrangements may have on the Indian breweries is still uncertain. In 1890 they brewed about 5,192,000 gallons. The production has not increased since 1887."

1891-92.

"The importations of beer continue on the large scale which has marked recent years, about 2,974,000 gallons having been imported last year. In five years the imports have increased by as much as 39 per cent., the increase being steady year after year. The causes have been suggested in previous reviews. To some material extent they lie in the withdrawal of Government from the supply of beer to the British soldier in the Madras and Bombay Commands. Under these arrangements Indian beer was supplied under contract with the brewers, but the soldier seems to prefer imported beer, and consequently there is a large increase in the imports into Bombay and Sind as also Burma (which is part of the Madras Command). The quantity of beer brewed in India has not increased in recent years. From 1887 to 1891 the returns give the following quantities:—5,085,000 gallons; 5,352,200 gallons; 5,171,700 gallons; 5,192,600 gallons; 4,745,800 gallons."

1892-93.

"The increase in malt liquor (imports), which has been so marked since 1886, still attracts attention. Last year 3,052,894 gallons were imported, being nearly three times the average quantity imported before 1886. The bulk of the beer is imported from the United Kingdom, the imports from Germany being only 118,000 gallons; but the quantity of German and Austrian beer drunk in India is not quite accurately indicated by the place of shipment, some still being imported indirectly from Germany and Austria by way of England. Thus there were imported into the port of Calcutta alone in the year 147,000 gallons of German and Austrian beer.

"The competition of Indian with imported beer does not develop. There has been no increase since 1887 in the quantity brewed, which, in 1892, amounted to 4,831,000 gallons. Of this, 2,748,000 gallons were

bought by the Commissariat for the troops. In Madras and Bombay the Government has withdrawn from the supply of beer to the army, and this withdrawal partly accounts for the increase in the quantity of beer imported."

NOTE ON INDIAN MALTING BARLEYS.

The following notes were furnished in connection with samples of the malting barleys used by the various breweries which have been sent to the Imperial Institute :—

MESSRS. MEAKIN & Co.

(Breweries at Kasauli, Simla, Dalhousie, Chakrata, Ranikhet, Darjeeling, and Poona.)

Mr. H. G. Meakin reported that "the Indian barleys vary very greatly in quality according to the season, with a favourable seed time, rain at the end of December or early in January, and again in February. With good harvest weather the barleys are of very fair quality. I usually purchase in the Lower Panjáb, *i.e.*, Rewari, Furrucknuggur district, and also in Ferozepur, Batinda district; but very good barley is grown in the Chandausi district, in Rohilcund, and in North Etawah; but the quality varies annually according to the rainfall. This season (1892) all barley is poor in quality owing to want of rain in December and January, and high winds in March. I reckon that a good Indian barley, well screened through Boby screens, should weigh 54 to 55lb per imperial bushel."

MESSRS. MACKINNON & Co.

(The old Brewery, Mussoorie.)

Messrs. Mackinnon & Co. reported that "we are obliged to use the plains-grown barleys for malting, for want of better. The hill-grown barley is much better adapted for this purpose, but the quantity procurable in our neighbourhood is very small and precarious. This year (1892) we have been unable to procure any."

MESSRS. DYER & Co.

(Breweries at Solon, Lucknow, and in Burma.)

Messrs. Dyer & Co. reported that "the barley used at our several breweries is chiefly obtained in the Rewari district, and we even ship it to Burma, where no native-grown barley is procurable."

THE NAINI TAL BREWERY Co., LD.

(Breweries at Naini Tal and Seoni.)

Mr. S. Whymper reported that "the barley used us by for malting purposes is grown in the Rewari district, and weighs 55½lb per bushel. Of late years we have only used barley purchased at Rewari, and grown

in that district. The barley procurable at the other markets in these parts (Cawnpore, Hardoi, Bareilly, Chandausi, etc.,) having proved of very inferior quality and very unreliable, their use has been entirely discontinued by us."

EDGAR THURSTON,
*Offg. Reporter on Economic Products
to the Government of India.*

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1891.

	year			REMARKS.
	1890.	1891.	1892.	
Madras	117,251 289,362	108,985 162,391	214,511 ...	* Brewing ceased in 1886. Brewing ceased 15th November 1891.
	406,613	271,376	214,511	
Bombay	609,995	393,346	573,315	
Bengal	47,736	38,934	42,282	
North-W Oudh	344,412 176,607 215,163 99,550 47,628 392,526	324,702 181,977 199,152 97,250 67,110 394,362	405,000 121,217 128,466 78,246 61,611 453,384	
	1,275,886	1,264,553	1,247,924	
Punjab	439,443 757,350† 26,460 24,273 270,162 48,708 495,774‡	449,064 648,810§ 27,324 21,640 246,996 57,564¶ 563,166§	450,000 738,828 18,447 28,366 281,556 58,104 334,638	† April 1888 to March 1889. ‡ April 1889 to March 1890. ¶ November 1890 to October 1891. § April 1890 to March 1891.
	1,062,170	2,014,564	1,909,939	
Burma	...	...	...	Closed.
	270,666	227,608	270,666	

1.—Breweries in operation in British India during the Calendar years 1884 to 1891.

Provinces.	Name of Town or Station at which located.	Year in which established.	Estimated outturn in gallons of Ale, Beer, and Porter during the year									REMARKS.
			1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	
Madras	Aravenghat (3 miles from Coonoor)	1884	7,025	1,606	...*	...	48,160	110,846	117,251	108,985	214,511	* Brewing ceased in 1886. || Brewing ceased 15th November 1891.
	Nilgiri (in Ootacamund)	1879	190,925	310,302	635,985	598,374	470,934	336,558	289,362	162,391||	...	
	TOTAL . . . . .	...	197,950	311,908	635,985	598,374	519,094	447,404	406,613	271,376	214,511	
Bombay	Poona (Dapuri)	1885	...	..	513,000	554,164	554,948	501,816	609,995	393,346	573,315	
Bengal	Sonada (Darjeeling)	1885	...	21,816	42,000	42,450	53,622	35,640	47,736	38,934	42,282	
North-Western Provinces and Oudh	Mussooree	1850	262,520	298,296	368,820	399,816	367,308	411,183	344,412	324,702	405,000	
	Mussooree	1876	271,352	382,698	205,398	279,612	267,453	183,591	176,607	181,977	121,217	
	Naini Tal	1876	153,252	156,600	159,084	162,972	216,486	229,014	215,163	199,152	128,466	
	Ranikhet	1878	39,096	70,000	77,500	77,500	127,872	106,496	99,550	97,250	78,246	
	Chakrata Cantonment	1880	26,784	37,884	86,724	55,276	37,320	72,500	47,628	67,110	61,611	
	Sahjika-bagh (Lucknow)	1882	358,938	346,113	415,368	437,886	470,556	346,626	392,526	394,362	453,384	
	TOTAL . . . . .	...	1,111,942	1,291,591	1,312,894	1,413,062	1,506,995	1,349,410	1,275,886	1,264,553	1,247,924	
Punjab	Kasauli	1850	336,000	316,000	526,303	500,000	495,918	450,000	439,443	449,064	450,000	† April 1888 to March 1889. ‡ April 1889 to March 1890. § November 1890 to October 1891. § April 1890 to March 1891.
	Murree	1860	575,838	644,058	733,644	890,784	948,519	1,148,949†	757,350‡	648,810§	738,828	
	Simla	1860	31,212	28,944	23,000	30,000	24,642	24,000	26,460	27,324	18,447	
	Simla	1876	25,000	22,000	33,061	27,041	27,243	28,701	24,273	21,640	28,366	
	Solon	1877	304,776	279,828	258,471	251,505	391,797	267,408	270,162	246,996	281,556	
	Dalhousie	1881	28,600	28,600	38,000	50,000	43,524	45,468	48,708	57,564||	58,104	
	Rawalpindi	1888	...	...	...	...	...	205,632‡	495,774‡	563,166§	334,638	
	TOTAL . . . . .	...	1,301,426	1,319,430	1,612,479	1,749,330	1,931,643	2,170,158	2,062,170	2,014,564	1,909,939	
Burma	Rangoon	1873	8,602	3,205	...	...	...	...	...	...	...	Closed.
	Mandalay	1886	...	...	...	296,946	287,469	232,804	279,666	337,608	350,676	
	TOTAL . . . . .	...	8,602	3,205	...	296,946	287,469	232,804	279,666	337,608	350,676	
Mysore	Bangalore	1869	74,196	108,702	107,028	107,784	136,296	133,272	136,016	140,724	180,738	
	Bangalore	1874	60,264	79,326	81,216	85,914	95,634	95,850	100,980	108,864	159,624	
	Bangalore	1880	24,300	14,364	13,122	12,258	14,580	15,886	13,716	8,802	5,400	
	TOTAL . . . . .	...	158,760	202,392	201,366	205,956	246,510	245,008	250,712	258,390	345,762	
Baluchistan	Kirani, near Quetta	1886	...	...	85,914	224,748	251,910	189,486	259,794	167,032	146,718	
TOTAL BRITISH INDIA			2,778,680	3,150,342	4,403,638	5,085,030	5,352,191	5,171,726	5,192,572	4,745,803	4,831,127	

2.—Ten years' progress in the Brewing Industry in British India.

	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
Number of breweries at work each year	17	17	18	19	19	20	21	22	22	22	21
Capital employed (as far as known) Rupees	12,50,000	15,00,000	12,00,000	12,00,000	12,00,000	12,00,000	17,00,000	17,00,000	17,00,000	17,00,000	17,00,000
Quantity of Ale, Beer, and Porter produced Gallons	2,594,667	2,597,298	2,778,680	3,150,342	4,403,638	5,085,030	5,352,191	5,171,726	5,192,572	4,745,803	4,831,127

3.—Quantity, in gallons, of Indian-brewed Beer purchased by Commissariat Department.

	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
In Bengal	872,296	1,298,773	1,764,927	1,699,914	1,936,221	1,835,759	1,982,777	2,218,069	2,637,534	3,141,227	2,592,111	2,390,632	2,100,624	2,560,629
In Madras Presidency . . . . .	...	...	...	...	90,948*	148,512*	170,456*	554,840*	841,672*	388,589	215,353	77,683	524	1,301
In Bombay . . . . .	...	...	...	...	...	46,228	113,568	565,552	699,452	719,272	639,576	444,268	648	61,255
In Burma . . . . .	...	...	...	...	...	...	...	...	...	379,087	331,255	180,438	127,162	125,180
	872,296	1,298,773	1,764,927	1,699,914	2,027,169	2,030,499	2,266,801	3,339,361	4,178,658	4,628,175	3,778,295	3,093,021	2,228,958	2,748,365

* Including Burma.